date: October 22, 1971

to: Distribution

from: W. G. Heffron

subject: S-1C Engine Out Software
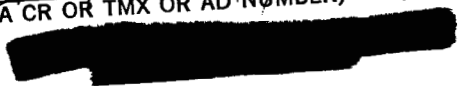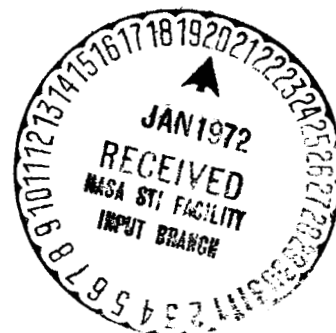Change - Case 310

B71 10016

ABSTRACT

MSFC has recently made a software change relative to reaction to S-1C engine out conditions. Most importantly, the change will reduce the launch abort entry g's below 16. I reviewed with MSFC and KSC the nature of the change and how it will be verified. Their proposed program seems acceptable and thorough.

(NASA-CR-125697) S-IC ENGINE OUT SOFTWARE
CHANGE (Bellcomm, Inc.) 4 p

N79-71724

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MEMORANDUM FOR FILE

     MSFC has, for the next flights, incorporated a software change which makes the response different depending on whether a top or bottom engine fails. Mr. L. Grant of MSFC and Mr. W. McPherson of IBM gave me information on the change as follows.

     When an engine fails and a discrete is received by the computer (based on chamber pressure) the software 1) calculates the beginning (immediately after L+14 sec) and end of an attitude freeze period, 2) calculates a time to stop the pitch angle change, 3) adjusts the backup F/M profile to account for the loss of the engine (this is used if an accelerometer fails). Items 1 and 2 have results which differ depending on whether the failed engine is upper, center, or lower since upper engine out tends to cause over 16G in an entry if a launch abort occurs, and since a bottom engine out tends to cause launch vehicle overheating. With no aborts, one engine out generally permits a continuation of the mission, even though the Earth Parking Orbit may get fairly eccentric.

     If a second engine fails between L+14 and L+135 sec there is an immediate CSM automatic abort, regardless of which engines fail. After L+135 the response differs. If the engines are adjacent, loss of attitude control would occur and so all engines are shut down and staging initiated at L+144 sec. If the engines are opposite, the remaining engines burn to depletion with the previously determined pitch profile being used. F/M backup is not adjusted, either. The crew may abort manually if they wish, but after L+135 it may be possible to complete the mission even with two engines out.

     MSFC will verify the changes using three facilities, the 360/44 + LVDC simulator, the 360/75 bit-by-bit simulator

and the elaborate LVDC + flight type hardware simulator. One and two engine out cases will be run as part of the normal verification.

Mr. C. Whiteside of KSC said KSC will not really accomplish a vehicle/software interface verification until the flight program arrives at L-9 weeks, one week before FRT. It used to be that MSFC supplied a Vehicle Test Program for early interface checkout, but as the flight program standardized, this fell into disuse and the last mission flight program was used for early checkout. The discretes from the engines are now changed so this is not a completely useful checkout technique. But since this is a well known change, it seems improper to argue that L-9 weeks is quite late to first make such an important vehicle/software interfice verification.

In summary, the change and its verification look well controlled.

2014-WGH-jct

W. G. Heffron

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           Change - Case 310

FROM: W. G. Heffron

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